generalization; namely that the occurrence of one cross-over in a chromosome lessens the likelihood that a second cross-over will take place in the same chromosome. This phenomenon the author describes as "interference." Following MORGAN, the author explains the phenomenon of crossing over as due to the twisting together of homologous chromosomes, and the failure to completely untwist when the chromosomes are separated—the "chiasmatype" of JANSSENS. Two cross-overs, or even three, may take place in the same chromosome when a series of loci sufficiently removed from one another are involved, but the frequency of such plural cross-overs is correspondingly low. While the percentage of cross-overs between any two "linked" characters was fairly constant in most of the material which has been studied by MORGAN and his students, the author points out that in certain strains there was a great deal of variation in the intensity of linkage. A part of this variability seems to be hereditary, but it is also suggested that some of the variation is probably due to conditions of food, etc. Most of the data regarding this variability are withheld for presentation and discussion in subsequent publications.

The author discusses the relation of chromosomes to Mendelian inheritance, and gives a list of 17 species of plants and animals in which clear cases of linkage have been described, and also a list of chromosome numbers which have been found in 25 species of plants and animals used in genetic experiments. He points out, as has been done by a number of geneticists, that each unit character is directly or indirectly due to the action of numerous Mendelian genes, and that each gene may and usually does affect a number of characters. The terminology used by the author, following that of MORGAN, is in one respect essentially the reverse of the one now most widely used, in that the symbols chosen to represent any Mendelian pair are based on the recessive instead of the dominant character; thus, instead of *Cc* for the factor for color, *Ww* is used, intending to suggest that in the absence of *W* a white individual results. This is just as usable a method of formulation as that now in general use, and has only the disadvantage that would be due to any such reversal of terminology. It has the strong pedagogical advantage that any dominant character is less likely to be misconstrued by the non-specialized reader, as the sole result of the single gene represented by the symbol.—G. H. SHULL.

A case of obligate symbiosis.—RAYNER[6] has discovered a very interesting case of obligate symbiosis between *Calluna vulgaris* and one of the mycorhiza. He has carried his investigations into careful experimental work, so that the details of the symbiosis in connection with the life history of *Calluna* have been discovered. It seems that infection by the fungus takes place shortly after germination, the source of the infection being the testa. This infection does not cease with the development of the mycorhiza in the roots, but affects

[6] RAYNER, M. C., Obligate symbiosis in *Calluna vulgaris*. Ann. Botany **29**:97–153. *pl. 6. figs. 4.* 1915.

all parts of the seedling, from whence it extends to all parts of the mature plant; that is, into the tissues of the stem, leaf, flower, and fruit. The ovary becoming infected, the mycelium enters the seed coats of the developing seeds, but the embryo and endosperm are free from infection. The fungus was isolated in pure cultures, and the seeds sterilized, so that a synthesis of the fungus of *Calluna* was accomplished. It was found that in case this specific fungus did not infect the growing seedling, it did not develop roots, and suffered complete inhibition of growth, remaining alive but rootless for several months. The fungus concerned is said to resemble the genus *Phoma*, and the author proposes that the species should be placed in a new subgenus, for which the name *Phyllophoma* is suggested.—J. M. C.

Development and distribution of Leguminosae.—ANDREWS[7] has brought together all the data dealing with the development and distribution of Leguminosae, and has reached certain conclusions of general interest. His thesis is that "the present distribution of plants and animals is the algebraic sum of the responses made by organisms to their changing environment during the whole of the known geological record, and the present adjustment of the activities involved has been obtained only after ages of development during various geographical changes." This is a problem, therefore, which involves the cooperation of geology, geography, and biology. ANDREWS finds that many uniform types of Leguminosae are widely diffused through the tropics, and that in extra-tropical countries these uniform tropical forms are represented by specialized types, which are mainly xerophytic. The details are fully presented, and it is thought that such study will throw light upon the nature of former land connections. For example, the author thinks that the Leguminosae show that New Zealand was separated from the tropics early in the differentiation of the family, while Australia was cut off at a date considerably later.—J. M. C.

Growth of Nereocystis.—Accurate data concerning the behavior of the large marine algae are much needed, the usual statements of the textbooks being vague and often misleading. This need promises to be supplied by the work of the Puget Sound Marine Station, whose first publication describes the growth of the blades of *Nereocystis Luetkeana*. Miss FALLIS[8] finds that this species grows as well when loosened from its foothold on the rocks, the holdfast serving only to fix the plant. Nor is the stipe, including the bulb, necessary for the growth of the blade, small pieces from which can grow independently. The growing region is not at the place of transition, between the blade and stipe, but its basal limit is at the beginning of the flattened part of the

[7] ANDREWS, E. C., The development and distribution of the natural order Leguminosae. Jour. Proc. Roy. Soc. N.W. Wales **48**:333–407. 1914.

[8] FALLIS, ANNIE L., Growth of the fronds of *Nereocystis Luetkeana*. Puget Sound Marine Station Publ. **1**:1–8. 1915.